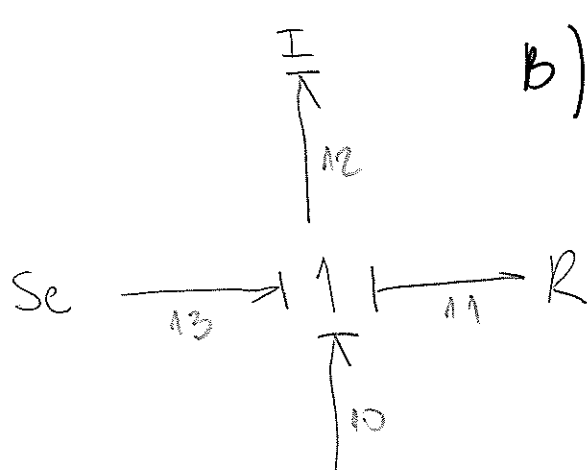
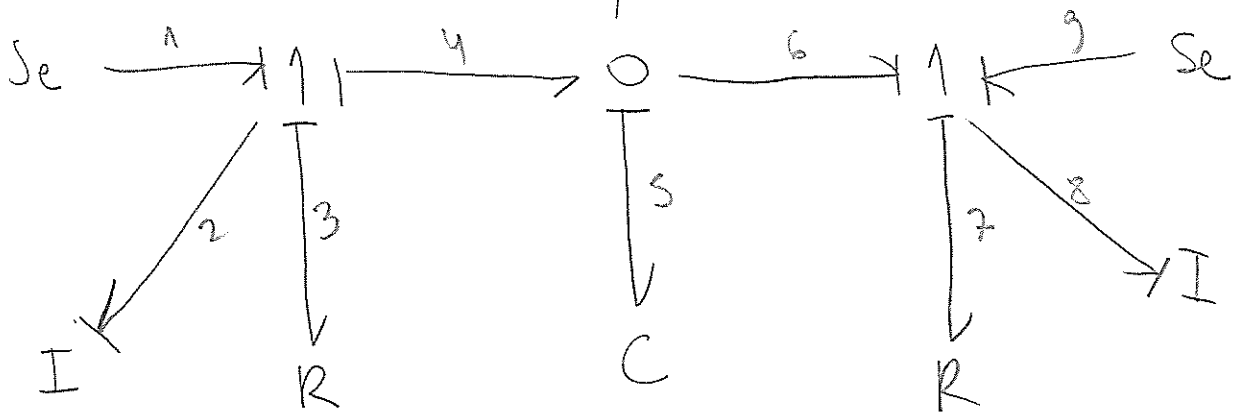


GABRILO - PROVA 3 MSD 2013.3

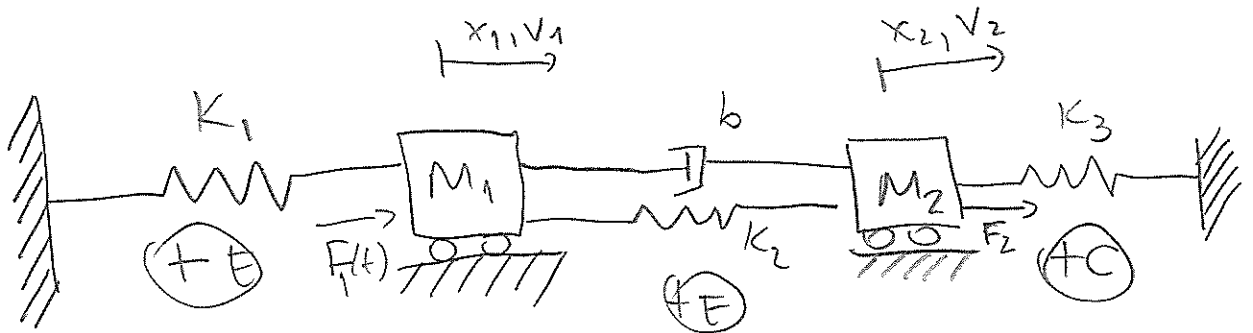
1) A)



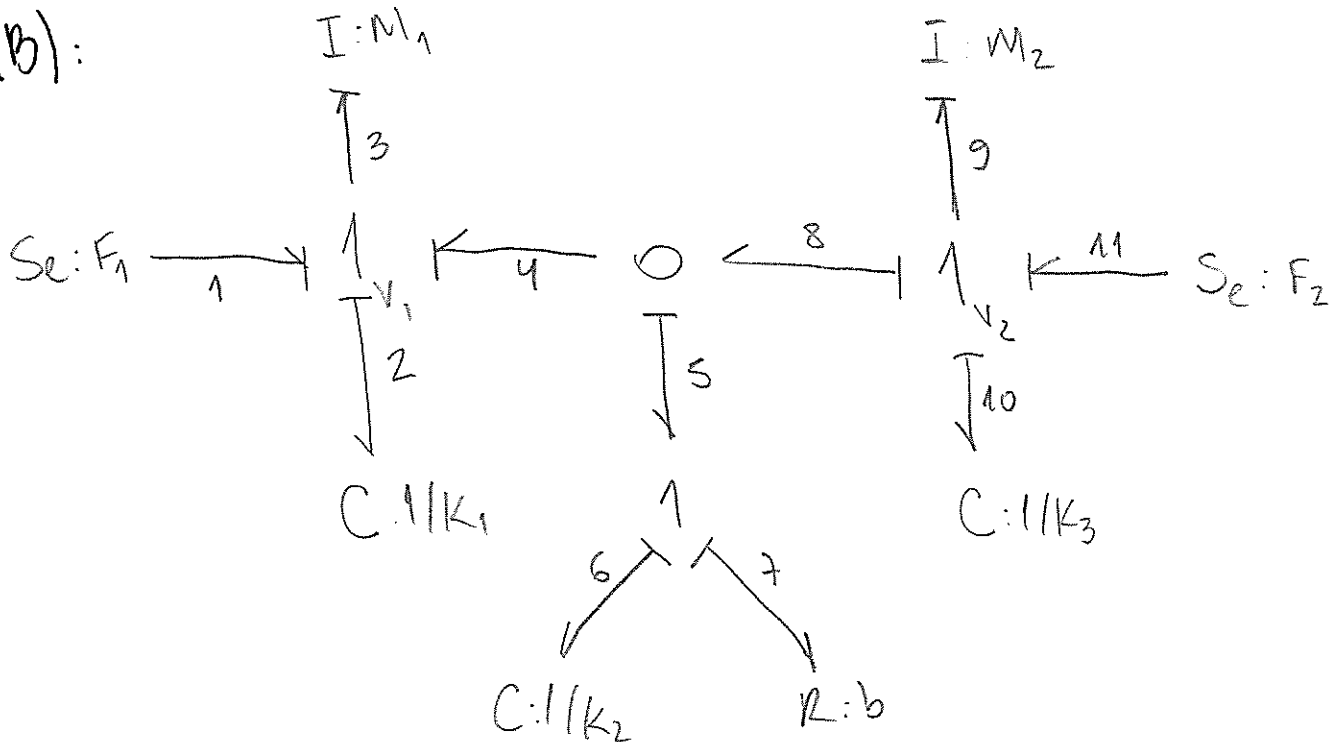
B)  $x = \begin{bmatrix} p_2 \\ q_5 \\ p_8 \\ p_{12} \end{bmatrix}; u = \begin{bmatrix} e_1 \\ e_3 \end{bmatrix}$



2)



A, B):



C) ESTADOS

ENTRADAS

SAÍDAS

$q_2$

$e_1$

$$x_1 = q_2$$

$p_3$

$e_{11}$

$$x_2 = q_{10}$$

$q_6$

$p_9$

$q_{10}$

$$\dot{q}_2 = f_2 = f_3 = \frac{1}{M_1} p_3 ; \dot{q}_{10} = f_{10} = f_9 = \frac{1}{M_2} p_9$$

$$\dot{p}_3 = e_3 = \underline{e_1} + e_4 - e_2 = \underline{e_1} + \frac{K_2 q_6}{b} + \frac{b}{M_2} p_9 - \frac{b}{M_1} p_3 - K_1 q_2$$

$$\dot{q}_6 = f_6 = f_5 = \frac{1}{M_2} p_9 - \frac{1}{M_1} p_3$$

$$\dot{p}_9 = e_9 = e_{11} - e_8 - e_{10} = \underline{e_{11}} - \underline{K_2 q_6} - \frac{b}{M_2} p_9 + \frac{b}{M_1} p_3 - \underline{K_3 q_{10}}$$

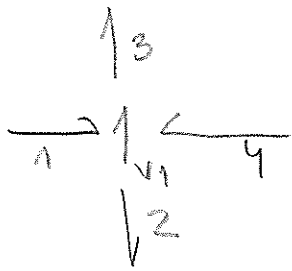
$q_2, p_3, q_6, p_9, q_{10}$

$$\begin{bmatrix} \dot{q}_2 \\ \dot{p}_3 \\ \dot{q}_6 \\ \dot{p}_9 \\ \dot{q}_{10} \end{bmatrix} = \begin{bmatrix} 0 & 1/M_1 & 0 & 0 & 0 \\ -K_1 & -b/M_1 & K_2 & b/M_2 & 0 \\ 0 & -1/M_1 & 0 & 1/M_2 & 0 \\ 0 & b/M_1 & -K_2 & -b/M_2 & -K_3 \\ 0 & 0 & 0 & 1/M_2 & 0 \end{bmatrix} \begin{bmatrix} q_2 \\ p_3 \\ q_6 \\ p_9 \\ q_{10} \end{bmatrix} + \begin{bmatrix} e_1 \\ 1 \\ 0 \\ 0 \\ 0 \end{bmatrix} \begin{bmatrix} e_{11} \\ 0 \\ 0 \\ 1 \\ 0 \end{bmatrix} \begin{bmatrix} e_1 \\ e_{11} \end{bmatrix}$$

$$\begin{bmatrix} q_2 \\ q_{10} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} q_2 \\ p_3 \\ q_6 \\ p_9 \\ q_{10} \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} e_1 \\ e_{11} \end{bmatrix}$$

# EQUAÇÕES AUXILIARES:

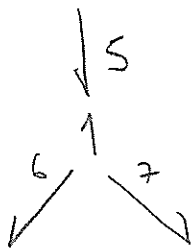
$$f_3 = \frac{1}{M_1} P_3 \quad ; \quad e_6 = K_2 q_6 \quad ; \quad e_7 = b f_7$$



$$f_9 = \frac{1}{M_2} P_9$$

$$e_3 + e_2 = e_1 + e_4$$

$$e_3 = e_1 + e_4 - e_2 \quad ; \quad e_2 = K_1 q_2$$



$$e_4 = e_5 = e_6 + e_7$$

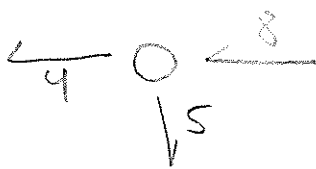
$$= K_2 q_6 + b f_7$$

$$= K_2 q_6 + b f_5$$

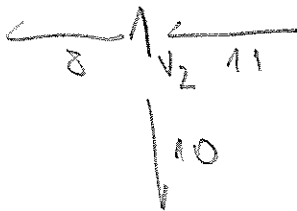
$$= K_2 q_6 + \frac{b}{M_2} P_9 - \frac{b}{M_1} P_3$$

$$f_8 = f_5 + f_4$$

$$\therefore f_5 = f_8 - f_4 = f_5 - f_3 = \frac{1}{M_2} P_9 - \frac{1}{M_1} P_3$$



f9



$$e_9 + e_8 + e_{10} = e_{11}$$

$$e_9 = e_{11} - e_8 - e_{10}$$

$$e_8 = e_5$$

$$e_{10} = K_3 q_{10}$$